

GHANA

COUNTRY STUDIES

GENERAL PURPOSE

1

FEEDBACK FOR THE DEVELOPMENT OF THE MONITOR'S METHODOLOGY

2

EXPLAIN HOW THE ANALYSIS OF THE MONITOR CAN BE USED IN A NATIONAL SITUATION

3

SERVE AS A KNOWLEDGE-SHARING MECHANISM FOR BEST PRACTICE AND CHANGE MANAGEMENT FOR THE BENEFIT OF OTHER VULNERABLE COUNTRIES

4

PROVIDE AN OUTSIDE SUPPORTING ANALYSIS OF INTEREST TO NATIONAL POLICY-MAKERS AND DEVELOPMENT PARTNERS



KEY FIGURES

Population	24,965,816
2012 GDP PPP (Dollars)	
Total	\$82,571,000,000
Per Capita	\$3,312
Real Growth	8.8%

ECONOMY

GDP by Sector	
Primary/Extractive	28.3%
Secondary/Productive	21%
Tertiary/Services	50.7%
Key Sector(s)	Services

SOCIO-ECONOMIC DEVELOPMENT

Human Development (Rank)	Medium (135th)
Life Expectancy	64.2 years
Annual Population Growth	2.3%
Illiteracy	20.2%
Urban Population	52.2%
Access to Electricity	60.5%
Gender Development	122 nd
Undernourished Population (2006/08)	5%
Living below poverty line (\$1,25/day)	30%
Population without Improved Water Source	15.3%
Official Development Assistance (% of GDP)	6.1%
Public Health Expenditure	6.9%
Public Education Expenditure	5.4%

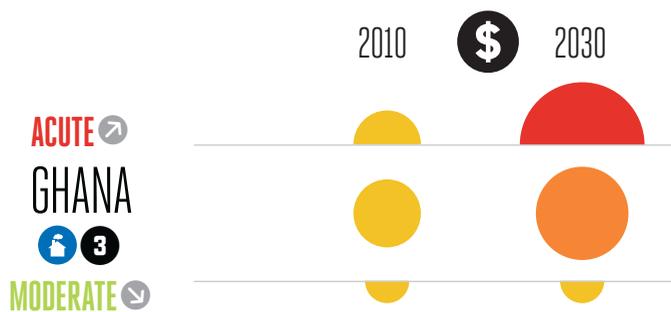
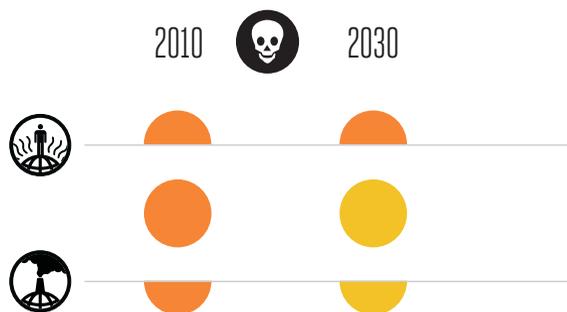
CLIMATE/GEOGRAPHY

Climate Zone	Dry and wet tropical
Projected Rainfall Change	20-30% reduction
Tropical Cyclones	No
Desertification	Yes
Low-Elevation Coastal Zone (10m and below)	1%
Forest Cover Change (1990-2008)	30.6%

MIGRATION/DISPLACEMENT

Emigration Rate	4.5%
Immigrants as Share of Total Population	7.6%
Internally Displaced People	None

Impact Areas	Indicator	Confidence	Bias	Vulnerability	
				2010	2030
CLIMATE	DROUGHT	✓		Yellow	Yellow
	FLOODS & LANDSLIDES	✓	♀	Green	Green
	STORMS	✓		Green	Green
	WILDFIRES	✓		Green	Green
	BIODIVERSITY	✓		Green	Yellow
	DESERTIFICATION	✓		Yellow	Yellow
	HEATING & COOLING	✓		Green	Yellow
	LABOUR PRODUCTIVITY	✓	♂♀	Red	Red
	PERMAFROST	✓		Green	Green
	SEA-LEVEL RISE	✓		Green	Green
	WATER	✓		Green	Green
	DIARRHEAL INFECTIONS	✓		Red	Red
	HEAT & COOL ILLNESSES	✓		Yellow	Yellow
	HUNGER	✓		Orange	Yellow
	MALARIA & VECTOR BORNE	✓		Yellow	Green
	MENINGITIS	✓		Yellow	Yellow
	AGRICULTURE	✓		Orange	Red
	FISHERIES	✓		Yellow	Red
	FORESTRY	✓		Yellow	Orange
	HYDRO ENERGY	✓		Green	Green
	TOURISM	✓		Green	Green
TRANSPORT	✓		Green	Green	
CARBON	OIL SANDS	✓		Green	Green
	OIL SPILLS	✓		Green	Green
	BIODIVERSITY	✓		Yellow	Yellow
	CORROSION	✓		Green	Green
	WATER	✓		Green	Green
	AIR POLLUTION	✓		Yellow	Yellow
	INDOOR SMOKE	✓	♀	Yellow	Yellow
	OCCUPATIONAL HAZARDS	✓	♂	Green	Yellow
	SKIN CANCER	✓		Green	Green
	AGRICULTURE	✓		Green	Green
FISHERIES	✓		Green	Green	
FORESTRY	✓		Green	Green	



“Unbearable” was a word commonly offered up by residents of rural communities in Ghana visited by the research team, emblematic of their view of the rising heat. Ghana was never a cool country, but an increase in average temperatures of 1 degree Celsius (1.8 degrees Fahrenheit) has been recorded over the past half-century. In comparison to Ghana in the 1960s, the effect of this seemingly small change in temperature is striking: there are now 50 more “hot” days and almost 80 “hot” nights every year (McSweeney et al., 2012). In addition to temperature, floods, wind and rain storms, as well as changes in the pattern of rainfall have become serious climate-related concerns for Ghana today (EPA-Ghana, 2011).

Most ecological zones of Ghana are hit by this rapid change in climate with effects already manifested in major sectors of the economy, such as agriculture, fisheries, and forestry, with some of these ramifications triggering severe economic and social decline, especially in rural areas. The success of Ghana is a beacon for Sub-Saharan Africa, which is plagued in many places by extreme poverty, hunger, suffering, conflict, and instability. As this report reaches publication, a humanitarian emergency across the Sahel is ongoing and extending through West Africa with some 20 million people in the grip of a major food crisis (Oxfam, 2012).

All of the drivers of climate change that harm: heat, unpredictable rainfall, changes in the timing and length of the crop season, sea level rise, ocean warming, to name only a few, will only intensify and hasten with each passing decade.

Few developing countries anywhere in the world offer meaningful models for tackling the climate problem at the national level. Even model adaptation options—such as planting medium heat-tolerant maize varieties and delaying sowing dates to minimize climate change impacts—present challenges related to everything from technology transfer to cultural beliefs (Tachie-Obeng et al., 2011). However, delaying investment to attenuate the losses and risks faced by climate change only leads to still higher costs, already estimated at several percentage points of Ghana’s GDP.

Climate change and/or the carbon economy are far from being Ghana’s only concerns. Indeed, with each climate-related issue, additional social, economic, and environmental problems combine to heighten vulnerabilities and the level of harm generated through the impact of climate change, which itself exacerbates economic, social, and environmental problems.

With limited resources, cost-effective solutions will have to explore the range of competing factors responsible for vulnerability and impact in the context of climate change. It is also an opportunity to revisit and address other longstanding problems, including gender inequality, deforestation, unsustainable fishing, and barriers that limit better use of technologies to drive social and economic activities and enhance resilience. Together with the affected communities, solutions can be found to the current challenges Ghana faces. The average temperature in Ghana has risen by around 1 degree centigrade (1.8° Fahrenheit) since the period from the 1970s to the 2000s. Should Ghana warm by another 3°C (5.5°F) in the 50–60 years to come, the human, economic, and environmental damage will be severe. What happens beyond the next few decades is now in the hands of national policymakers in the world’s major economies.

Ghana could harness its successes to date by tackling climate change risks concertedly, and in doing so, not only improve the resistance of its own economy to these effects, but also serve as an inspiration in the coming decades to other countries in the region, which all face similar problems.



- 1 ACCRA
- 2 NEW NINGO
- 3 ADA FOAH
- 4 KETA
- 5 BOLGATANGA



MULTI-DIMENSIONAL CLIMATE VULNERABILITY: **ACUTE** ↗



MULTI-DIMENSIONAL CARBON VULNERABILITY: **MODERATE** ↘

CAPACITY: **RESTRICTED**

POPULATION 2010/2030: **24/32 MILLION**

GDP 2010/2030 (PPP): **65 BILLION/210 BILLION USD**

GDP PER CAPITA 2010/2030 (PPP): **2,650/6,500 USD**



BACKGROUND AND CONTEXT

BACKGROUND AND CONTEXT

With close to 25 million inhabitants, Ghana is a mid-sized and rapidly growing West African country. Now considered a middle-income country (lower-middle income) by the World Bank, Ghana is bordered to the north by Burkina Faso and to the east and west by Togo and Côte d'Ivoire, respectively. Ghana's climate is tropical monsoon, with relatively low-elevation geography, and clear regional differences in climate between the savannah (northern and east coast) and more humid southwestern forested areas along the Gulf of Guinea. Ghana is similar in size to the United Kingdom.

Ghana's real GDP grew at an average of 6% in the first decade of the 21st century and continues with growth for 2012 estimated by the IMF at almost 9% (IMF WEO, 2012). Ghana's per capita income is still very low, at around 3,000 dollars (PPP) or 1,700 US dollars (nominal). Income inequality is also high, with nearly half the urban population living in slums (UN-HABITAT, 2012). Ghana is not considered a Least Developed Country by the United Nations but its capacity is considered to be Intermediary, due to comparatively limited human and infrastructure assets, and despite relatively strong government effectiveness. The climate-sensitive agricultural sector still represents around 30% of GDP and employs nearly 60% of the workforce.

Ghana recently discovered large-scale new offshore oil and gas reserves, which are expected to boost national income further in the coming years. Ghana also produces large amounts of cash-yielding cocoa and gold that are mainstays of its economy. Heavy reliance on one type of crop may, however, represent a serious latent but systemic climate risk for Ghana's agricultural sector, where climate change to make plant diseases and pests more prevalent in the humid southern zone where much of the cocoa is grown (Bronzizio

and Moran, 2008). Nevertheless, continued national economic growth is well assured in the medium term. But whether or not Ghana's climate change policies are effective will be increasingly important in determining the extent and distribution of this growth, and the sustainability of its economic development as currently programmed.

GHG emissions remain very low at 3.2 tons per capita and are not expected to even exceed 3.5 tons per capita by 2020 (Climate Analytics, 2012). Deforestation is at very high rates and currently represents over 40% of total emissions; a little more than a decade ago, the forestry sector was acting as a net carbon sink, not an emitter (EPA-Ghana, 2011). Urban air pollution is beginning to become more serious, but household fuels are a much greater health concern, since indoor firewood stoves are still widely in use. Moreover, 40% of all homes lack access to electricity.

As is the case for many countries in close proximity to the equator, the environmental vulnerability of Ghana is extreme. Ghana is exposed to fisheries impacts, due to rising water temperatures and coastal erosion caused by the rising sea level; in the north, the increase in heat is occurring in a continental climate not restrained by the proximity of the sea. These effects are compounded by floods, drought, wildfires, land degradation, soil erosion, the threat of desertification, and the prevalence of diseases, such as cholera and meningitis. Major cash and staple crops, such as cocoa and maize will be affected in growing measure by climatic shifts, including increased temperature, the contraction of cropping seasons and changes in the distribution of rainfall.

In both urban and rural communities, socio-economic vulnerabilities are also extreme. Cities such as Accra have sprawling slums which form hazard-prone zones, exposing populations to unsafe water, restricted sanitation, and deadly flood

THE MONITOR'S ASSESSMENT OVERVIEW / CLIMATE CHANGE

risks—much of Accra was flooded in 2011, causing significant loss of life. In rural areas, subsistence farming is still widespread, and a lack of basic agricultural inputs and infrastructure, such as irrigation, roads and storage facilities make this group less adaptive to changes in climate.

THE MONITOR'S ASSESSMENT

OVERVIEW

Despite its relatively strong economic position in West Africa, Ghana is among the countries most vulnerable to climate change. According to the Monitor, Ghana's economic development will have already been significantly compromised due to changes in the climate that have already taken place.

The multi-dimensional vulnerability of Ghana to climate change is considered in the highest category of Acute, with vulnerability steadily increasing as global and local temperatures rise. Ghana's vulnerability to carbon impacts is considered Moderate and is actually declining, due mainly to the expectation that agriculture might benefit from carbon fertilization as CO₂ levels rise, and because economic development should lead households to adopt less hazardous cooking and heating practices over time. Both human (Severe) and economic (Acute) vulnerability are very high. Climate change is estimated to claim around 2,000 lives each year in 2010, while carbon-related mortality is at 13,000 deaths per year; each impact is expected to decline slightly by 2030 as a share of overall population, due to anticipated socio-economic gains between now and then. Losses due to climate change are estimated at 4% of GDP in 2010, rising to 9% of GDP in 2030. Carbon losses are stable at approximately 1.5% of GDP.

CLIMATE CHANGE

Following are the most serious climate change impact areas as assessed (for 2010/2030) in order of the scale of

GDP losses, from highest to lowest:

- LABOUR PRODUCTIVITY, **ACUTE/ACUTE** 3.0%/6.1% of GDP
- FISHERIES, **HIGH/ACUTE** 0.3%/1.1% of GDP
- AGRICULTURE, **SEVERE/ACUTE** 0.4%/0.7% of GDP
- SEA-LEVEL RISE, **MODERATE/MODERATE** 0.3%/0.4% of GDP
- BIODIVERSITY, **MODERATE/HIGH** 0.1%/0.2% of GDP

The most serious health effects are Diarrheal Infections, Hunger, Heat and Cold Illnesses and Meningitis. Heat and Cold Illnesses relate to the impact of heat waves on chronic disease sufferers, particularly the elderly. While mortality rates are not alarmingly high, more than 1 million people are estimated to be affected on average each year, due to the impact of climate change on diarrheal diseases, and over 400,000 people suffer from hunger.

The impacts for Labour and Sea-Level rise carry a relatively high degree of certainty, while other areas are more of an indication, due to the limitations of the models used and agreement on the signal of key changes, such as rainfall. Other areas of high vulnerability constituting serious concerns for affected communities include Desertification (High) and Drought (High), although these are not as significant in economic terms on a national level. Desertification is nevertheless estimated to already be affecting 75,000 people in Ghana, which could rise to 200,000 people at risk by the year 2030. By 2030, drought could cause 15 million dollars of damage on average each year to farmers, especially small-scale and subsistence farmers with low-resilience to these impacts. Floods and Landslides have been assessed as a Moderate concern; however, field research demonstrated that flooding is a major and growing concern in both urban and rural areas. For instance, recent large-scale floods in October 2011 inundated large parts of downtown Accra, reportedly killing 14 in the greater



CARBON ECONOMY

Accra region and 33 nationwide, according to Ghana's National Disaster Management Organization (NADMO). The international disaster database records 300 deaths due to floods for the whole of the last two decades since 1990, not including the 2011 floods (CRED/EM-DAT, 2012).

The only positive effect Ghana is estimated to experience on the basis of the Monitor's assessment is a less than 0.1% of GDP boost to Hydro Energy, as a result of small, although uncertain, increases in annual river flow that are projected by some models for this region of the world. Wildfires are a legitimate concern in Ghana and increased aridity and drought in certain areas will increase the likelihood of fires. However, since Ghana is projected to experience some increased rainfall, the final outcome of the role of climate change on wildfires is ambiguous, so vulnerability is assessed as Low.

CARBON ECONOMY

With respect to carbon economy costs, in human terms Indoor Smoke claims an estimated 10,000 lives each year today, followed by over 2,000 deaths associated with urban air pollution. Air Pollution deaths are expected to grow as a share of population to close to 4,000 deaths per year in 2030. However, Indoor Smoke is expected to decline to around 8,000 deaths per year by that time.

In economic terms, the largest carbon impact is to Biodiversity at 1% of GDP in 2010, growing to 2% of GDP by 2030. Health impacts are the next biggest loss to GDP at 0.8% of GDP, declining to 0.4% of GDP by 2030. The agricultural sector is still generally unaffected by pollution, but could benefit from higher CO₂ levels, in which case gains are estimated at 0.1% of GDP in 2010 and 0.8% of GDP in 2030. Thus, any current benefits of CO₂ fertilization are outweighed three times over by costs related to climate change. By 2030, scientists predict that all of the future impacts of climate change will be compensated by increases in plant growth due to CO₂

NATIONAL RESPONSE STATUS

fertilization. The very latest research is nevertheless more pessimistic than the Monitor's assessment on the possible extent of such benefits (Ainsworth et al., 2008; Leaky et al., 2009). This result should therefore be treated with much caution. Field research undertaken for the purpose of the Monitor in Ghana identified key agricultural regions already suffering severe stress and fundamental challenges relating to climate-tied shifts carrying serious humanitarian ramifications, including hunger and other diseases. Local research has also documented the climate-related challenges facing core staple crops, such as cocoa and corn (Tachie-Obeng et al., 2011). Carbon fertilization benefits are known not to accrue under stressed conditions (IPCC, 2007). Nonetheless, improving the resilience of Ghana's agricultural sector to climate change would certainly increase its chances of benefitting from any possible positive effects of high CO₂ levels, if they are ever to materialize; either way, adaptation to climate change remains a core priority. The health related impacts of Indoor Smoke and Air Pollution are considered relatively reliable, whereas Biodiversity and Agriculture should be considered more indicative or less certain.

NATIONAL RESPONSE STATUS

Policy development on climate change in Ghana is a new and rapidly advancing focus of energy for key government departments with competencies relating to the environment and disaster issues. The government has recognized climate change as a current concern for the country's economic output. It is viewed as a development challenge requiring action to address climate change so as to ensure that national progress is not derailed. This is at the core of ambitions to mainstream climate change into key planning processes at national, regional and district levels,

and into the Ghana Shared Growth and Development Agenda. In this spirit, an active consultation process is now underway aiming to develop a National Climate Change Policy. The National Policy has three core objectives: 1) effective adaptation to climate change, 2) social development, and 3) low carbon growth. The government has also identified the following seven pillars which it is planning to build upon in order to achieve those objectives:

- Governance and coordination
- Capacity building
- Research and knowledge management
- Finance
- International cooperation
- Education, communication and public awareness
- Monitoring and reporting

There exists a National Climate Change Committee grouping some 14 government entities together with development partners, including foreign assistance donors. It has been mandated to drive the climate change policy development work forward and is hosted by the Ministry of Environment, Science and Technology. A National Adaptation Strategy for Ghana has been completed following a detailed process of stakeholder inputs from multiple sectors, with the launch scheduled to take place before the end of 2012.

While the policy process is moving in a very promising direction, Ghana still lacks government policies specifically designed for responding to climate change. In particular, at the community level, district development plans viewed did not account for the additional stress resulting from climate change, nor did such plans contain climate change specific response considerations, whether to reduce carbon intensity or to address climate impacts. Nevertheless, several government entities are dealing with climate change issues as a part of their operational mandates and daily concerns, such as the Environmental Protection Agency-Ghana (EPA-Ghana) and the National Disaster Management Organization (NADMO). And there was evidence of active work on the part

CLIMATE FINANCE

of government, international, and local non-governmental organizations and foreign assistance partners in many climate change related areas of concern, from coastal defences, to food security, and health and sanitation issues.

CLIMATE FINANCE

In 2010, Ghana received close to 80 million US dollars in public climate change finance from foreign sources, making Ghana the 31st largest recipient that year among developing countries. This amount represented 0.25% of Ghana's GDP— compare this to the amount received by Vietnam (also studied in this report), which represented 0.5% of Vietnamese GDP in 2010. The largest bilateral donors of climate change finance in 2010 were Japan and France, which provided more loans for mitigation finance and only grants for adaptation. The component of those resources targeted to assist Ghana in adapting to the negative effects of climate change made up only about 10% of the total, or 10 million dollars. An order of magnitude increase in climate change finance for adaptation in Ghana would be needed, if a balance with respect to mitigation were to be achieved. Even such levels would likely fall far short of the actual requirement, considering the estimate that climate change already costs Ghana 4% of its GDP.

Deserving of high praise are Ghana's development successes in high rates of real GDP growth and the progress achieved towards the Millennium Development Goals to-date. There is, however, a risk that foreign development partner donors view those achievements and the discovery of important fossil fuel reserves as reasons for withdrawing international support. The research team which visited various regions in connection with this project found that, in certain cases, foreign assistance programmes were already being withdrawn from some of the most vulnerable communities. Climate change impacts



ASSETS

are now expected to accelerate very quickly, putting the development gains of Ghana at greater risk, in particular where last-mile efforts to empower the poorest of the poor have not succeeded. Ghana's forthcoming National Adaptation Strategy should provide a vehicle for donors to ensure that adequate support is provided to the country as it seeks to address these serious and growing concerns.

ASSETS

Ghana faces a number of capacity constraints that are commonplace for lower-middle income countries in sub-Saharan Africa. But Ghana also has a number of important assets at its disposal as it gears up to tackle climate change locally:

- **Community Reach:** With the National Disaster Management Organization (NADMO), Ghana has centrally organized government officials or trained volunteers on the ground in every district, if not every village. NADMO volunteers are mobilized and actively working to respond to and reduce risks for communities dealing with climate change and other threats to safety and livelihoods and their responsibilities include advocacy and emergency assistance. Given appropriate strategies and resources, the NADMO apparatus will be invaluable for ensuring that community-level actions are carried out among the most vulnerable groups.
- **Technical Capacity:** the Environmental Protection Agency-Ghana (EPA-Ghana), the lead institution for UNFCCC-related activities, has been establishing important foundations of local expertise on core climate-related concerns, as it serves as the main Country Implementation Institution for the technical coordination of activities on climate change, including specialized working groups and expert climate change study teams, all of which support national policy development and the implementation of climate change project activities.
- **Fiscal Resilience:** Ghana is financially

stable with relatively low levels of public debt and surging economic growth. There are significant and important infrastructure investments that Ghana will be making over the next 5 to 10 years as it reinvests its growing wealth back into the economy. Ghana has yet to commit streams of public funds to a formal climate change policy, but should consider allocating some specific levels of resources to its own domestic climate change policies while the economy is strong.

- **Health Insurance:** In all communities visited as a part of the field research for the Monitor, participation rates in local health insurance schemes were very high, with annual fees very affordable, in some cases as little as 5 US dollars (10 Ghanaian Cedis). Health insurance did not, however, cover preventative measures, such as insect-repellent infused mosquito nets or vaccinations. Therefore, preventative measures remain a challenge for communities themselves, the government and foreign aid programmes.
- **Indigenous Knowledge:** The long cultural history and traditions of the people of Ghana represents a great wealth of indigenous knowledge relating to the environment. As climate change brings rapid change to that environment, much of this knowledge is not only not obsolete, but has become more important and useful. In one region for instance, crickets, still announced the end of the warm season, even when the timing of the season had shifted considerably. Documenting and disseminating the best of indigenous knowledge to supplement highly technical or costly infrastructure responses to climate change would help to lower costs and improve impact.
- **Sound Policy Environment:** From the capital in Accra to the remote villages of northern Ghana, community leaders, NGOs, entrepreneurs, farmers, experts, and other members of civil society consistently expressed deep concern and interest in climate-related issues. The government



GAPS

is benefitting from the attention and knowledge as a part of the consultative process leading towards the National Climate Change Policy and should continue to promote that interest, which will likely pay dividends in terms of fine-tuned policies and more robust implementation.

GAPS

- Ghana still lacks a dedicated climate change policy and never issued a National Adaptation Programme for Action under the UNFCCC since it is not a Least Developed Country. So policy gaps are large for now, but will progressively be filled, as different aspects of the government's policy project come online. Some gaps in the general policy approach can still be identified, and should be reinforced:
- **Leadership:** As evident from the more than one dozen government entities already participating in Ghana's National Climate Change Committee, the challenge of coordinating and ensuring sound implementation of cross-sector challenges is immense. The government has already recognized the need for a dedicated statutory body on climate change to oversee the government response, enhancing coordination and avoiding duplication. However, executive leadership on climate change has been largely absent and does not appear to be a planned component of a climate change body for Ghana. Ghana might do well to take a cue from successful national policy approaches of other vulnerable countries, such as the Philippines or Vietnam, where there is direct involvement of the government executive branch, which issues formal policy directives to all other relevant organs of government.
 - **Prioritization:** The research undertaken for the Monitor revealed that the government of Ghana has yet to flag climate change as a key priority area in its formal discussions with leading development partner donors. As such, several donors had the impression that climate change is not a priority



- for the government. A key step to mobilizing enhanced international support for Ghana's domestic climate change policies is for the government to be unambiguous regarding the importance of the climate policy project for Ghana when interacting with foreign assistance partners.
- **Fragmentation:** Experts also expressed concern over the potential fragmentation of national efforts to address climate change, as wide-ranging initiatives were being pursued in different directions. Fragmentation risks exhausting precious capacities, especially in central government, and favouring project-based pathways over strategic approaches more capable of tackling systemic issues.
- **Reference Scenarios:** Ghana plans to publish national reference scenarios for climate change as part of its National Adaptation Strategy. But to date, it has lacked truly comprehensive and highly specific reference scenarios for all key regions of the country across all main climate parameters, including river flow, rainfall/runoff, temperature, sea-level rise, sea temperatures and acidity, wind, fire risk, flooding, and drought/extreme aridity. For example, scenarios for rainfall cited in the most recent UNFCCC National Communication are at odds with the analyses of some other leading experts, which point to increases not decreases in rain, although seasonal, not annual, declines of rainfall may be extreme, including during growing periods (EPA-Ghana, 2011; McSweeney et al., 2012; Tachie-Obeng et al., 2011). The regular updating and publication of new national reference scenarios is critical for guiding the progressive calibration of adaptation investments as knowledge evolves. Establishing scenarios through wide consultation that all key stakeholders can have confidence in, despite intrinsic uncertainties, is an important component in building strong support for the national response to climate change.
- **Donor Support Group:** There is no formal group involving a wide range of key foreign donors that is operationally

OTHER CHALLENGES AND OPPORTUNITIES

focused on supporting Ghana to develop and implement climate change policies. Best practice from other country experiences such as Vietnam point to the clear value of a donor support group that could add to the policy implementation efforts of Ghana on climate change and help to harmonize aid, avoid overlap and drains on capacity, track progress and results, and ensure that financial commitments match government defined priorities and needs as effectively as possible.

OTHER CHALLENGES AND OPPORTUNITIES

- *Access to Markets and Industry:* All rural areas visited by the research team had in common a near total absence of any local light industry operations aimed at processing and packaging the raw products of farmers and fishermen into finished goods that could be transported to reach non-domestic markets. This led to the paradox of purchasing boxed South African mango juice from a food stall to be consumed under a fully laden local mango tree. In the Gulf of Guinea, fishing boats from China, Japan and Korea plied the waters and sent back home the fruits of Ghanaian seas. Tragic outcomes also resulted: an unusual bumper crop of tomatoes that was left to spoil on the road led some farmers to commit suicide when they realized that their superb crop was unable to reach any market. Yet none of the communities visited had development plans in place to give incentives to local entrepreneurs or to attract investment to set-up freezing works for seafood, canning facilities for tomatoes, packaging houses for fruit juice, or any other light industrial facilities that would enable farmers to achieve higher prices for their goods, receive more from the commercial value chain, and ultimately increase profits and disposable income.
- *Energy and Carbon Markets:* The abundant heat and sunshine that is now a concern for Ghana as temperatures continue to rise, underscores the existence of a latent

wealth of solar energy that is not being harnessed anywhere. Programmes aimed at distributing efficient and clean-burning indoor cooking stoves would not only reduce disease, but also help stem deforestation, land degradation, and desertification, since communities rely heavily on local wood as the primary fuel. Making the most of new opportunities in the renewable energy sector was a major theme expressed in interactions with experts during the research work undertaken as a part of the Monitor's development. Ghana has yet to gain meaningful access to international carbon markets and to the support mechanisms that drive renewable sector growth in other developing countries. With only one project registered with the CDM and a handful of others under development, virtually no investment has yet been leveraged (UNEP Risoe, 2012). Making the most of a potential future forest carbon market (via REDD+) would help reverse the rampant deforestation that caused Ghana's forestry sector to transition from a net carbon sink to a major source of GHG emissions since only the late 1990s (EPA-Ghana, 2011). Public and private sector capacity building would need to be actively fostered in order to break through and stimulate serious progress for Ghana's renewable energy and carbon sink sector.

- *Migration:* Hallmarks of a long-term rural decline whereby traditional livelihoods faced ongoing erosion were evident in many of the communities studied for this edition of the Monitor. Seeing limited opportunities for themselves, young adults were migrating on a seasonal basis to the larger centres, where they seek informal employment. Men or couples whose livelihoods in agriculture or fishing have been compromised were also moving on a more permanent basis, sometimes leaving children behind in the care of elderly relatives or single mothers; these "stranded" homes were reported to be particularly food insecure and vulnerable: if a remittance did not come in a given

month for whatever reason, the children would go hungry. The situation is fuelling the rapid urbanization of Ghana's metropolitan centres, where slums have been steadily growing, with settlements often developing in marginal or high-hazard zones, such as river flood plains, creating additional risks. It is difficult to attribute a specific proportion of that migration to climate change. However, the change in climate has had a negative affect on agriculture and fisheries—which determine income levels—and stifles economic activity in mainstay rural sectors. The heat, the extreme and erratic nature of rainfall, the rise in sea-levels, the stress on biodiversity and forests, are all set to increase dramatically in the decades ahead. With it, migration pressures will only increase considerably.

- *Women's and Youth Empowerment:* Ghana is known to have low levels of gender-related development or high degrees of gender inequality that disadvantage women (UNDP, 2007; UNDP, 2011). The research undertaken as a part of the Monitor's development highlighted the extent to which women are currently marginalized from decision making on community issues at multiple levels. Many of the men interviewed as a part of the research conducted autonomously suggested that greater involvement of women would lead to more sensible decision making and community action; it was emphasized that women are more receptive to change. The same issues were understood to also apply to youth. Gender development and inequality in particular are highly correlated to climate change vulnerability according to the Monitor's assessment; this suggests that gains across the full spectrum of gender-related development would reduce levels of vulnerability to climate change, since women are understood to be more vulnerable to climate change in Ghana (EPA-Ghana, 2011). The advent of climate change therefore only strengthens the urgency of overcoming gender equality challenges in Ghana.



NORTHERN GHANA: BOLGATANGA-BONGO-NAVRONGO

The Bolgatanga-Bongo-Navrongo areas of the Upper East Region of northern Ghana is close to the border with Burkina Faso. It is a primary agricultural region, raising livestock and cultivating staples such as rice and millet, market vegetables, and orchard trees. About one million people inhabit the upper east region of Ghana, which covers some 9,000km². Northern Ghana is the hottest part of the country, where the so-called "Harmattan" winds blow in from the Sahara desert, and where the increase in heat and the number of hot days and hot nights has been the most extreme. The relentless rise in temperature in the years ahead will also continue to be the most extreme here (McSweeney et al., 2012).

The serious increase in heat the area is experiencing has triggered a downward trend in its core economic sector, agriculture, with negative impacts on the health of the region's population. Key concerns range from extreme flooding, drought, desertification, growing energy needs for cooling, and a declining biodiversity. Concerns were also voiced about the nomadic Fulani herdsmen, who cross from Burkina Faso and are indiscriminately cutting and burning the savannah vegetation and causing other social issues, as their bonds with local farmers are increasingly severed along with rural decline. Occupational heat stress is also endemic, since large numbers of subsistence farmers, anxious to feed their families and unable to work in the relative cool of the night, are obliged to work during the intense heat of the day. All of these effects have serious social and economic implications: the rapid pace of development that Ghana has experienced in other regions has not been enjoyed by this part of the country: every one of the dozens of people interviewed in different villages and centres across this region insisted that life had become much harder. Social vulnerabilities were also extreme: no running water or sanitation facilities of any kind in many households, less than 50% of households with electricity or lighting, no cooling units

or fans virtually anywhere, too few mosquito nets, very few vehicles, and no insurance for houses damaged by flooding and wind or for crops destroyed in drought or floods.

HEALTH

With a significant share of the population living without electricity, refrigeration, running water, or sanitation facilities, the deleterious effects of climate change on health are a major concern. High rates of all of the main climate sensitive diseases were confirmed: diarrheal diseases such as meningitis, cholera, and malaria. In some areas, a majority of households were considered food insecure. People living without any form of climate control would often sleep outside on the hottest nights and in doing so expose themselves to mosquito bites and vector-borne disease, especially malaria, compounding the climate stresses on their health. One local expert explained that people often suffered malaria two or three times a year. Certain villages were able to report on the number of deaths due to meningitis over the preceding few weeks—accounting for more than 10 fatalities in one village alone. In another village, the funeral procession of a victim made its way past the research team's interview site. While health insurance is now high—reported to be around 80% coverage—vaccinations against communicable diseases common in the area are not covered by the insurance schemes, even though some vaccination campaigns were also reported to be in effect. School feeding programmes were in place in many areas, with the local government and international NGOs such as the World Food Programme responsible for providing one meal per day. Hunger deaths were understood to occur in remote areas or where children were not able to attend school, and significantly low school attendance rates were confirmed. To prevent malaria, more bed nets were needed,

but most local experts stressed that education was needed. People were apparently unaware of the importance of basic safety precautions in everyday life, such as personal hygiene, proper waste disposal, or the need to avoid being exposed out of doors at dusk and dawn when mosquitos are most active. Investment in education campaigns and schools is therefore a priority. Ensuring access to clean water for households was also understood to make a significant difference, as is clear from current international knowledge on the issue (Jamison et al. (eds.), 2006).

SEASON SHIFT

A clear erosion of the agricultural system in the Bolgatanga area was reported and manifest. Local experts reported that key causes of this erosion have been the growing length of the hot dry season—traditionally from November to April—and the contraction of the traditional rainy season—April through October. Although farming is done in both seasons, the rainy season is the mainstay of the harvest. In the dry season, it is only possible to grow crops where there is irrigation, while in the wet season, much of the land is available for cultivation. Thus, the contraction of the growing season lowers overall agricultural potential. Rains that reportedly once began in April are now not beginning until May. The new timing has a number of other consequences: one example provided was that butterflies have been slower to adapt their behaviour to the new season onset and caterpillar larvae now exit the cocoon when crops are at their most vulnerable early stages.

DROUGHT AND DRY SEASON HEAT

The dry season itself is now unbearably hot and even dangerous: people exposed outside in the heat are considerably more susceptible to deadly meningitis. It is more difficult for farmers to produce crops in the dry season, if only because of the extreme



levels of heat stress as they toil in the fields. Moreover, periods of drought are now very severe, since the heat is so much more intense, and crop productivity suffers whenever the heat is not offset by generous and evenly spread rainfall, reported to be rarely the case anymore. Rainfall in Ghana reached its lowest in the 1970s and early 1980s; although it has since increased from 2000, it is still below the 1960 baseline. But it is not keeping pace with the increase in temperature and so the evaporation rate of water for the region is increasing. As a result, rainfed agriculture is undergoing a transition away from optimal growing conditions, resulting in lower plant productivity and yield, while reservoirs that supply irrigation are becoming less efficient. Thus, most people migrate to southern Ghana during the dry season.

EROSION OF LIVELIHOODS

To cope with declining yields, farmers have begun to take measures, such as selling their livestock. Farmers who might have had five or six animals, might now have only one or two—others none at all—and may be worried about how they will cope with another difficult season. Such measures hardly constitute a sound long-term strategy, since the hope for a return to bountiful harvests of days gone by is unlikely, given the projections for climate change to come. Residents recalled times in the past when Bolgatanga area was once the breadbasket of Ghana. It is in this dead-end context that farmers were reported to have committed suicide, when their unusual bumper crop of tomatoes spoiled on the roadside for want of buyers.

These developments have upset the delicate balance of these rural communities. Since farmers now own less livestock, the relationship between farmers and nomadic people who settle in the less fertile surrounding areas has also been compromised. In the past, farmers would entrust the nomadic peoples from Burkina

Faso (Fulani herdsmen) with their livestock in return for payment, either in-kind or in the form of farm produce. Thus, the nomadic peoples have also been deprived of a source of income and livelihood, and are now being reported to be engaging in a growing number of criminal acts, such as theft, violence, and other social problems, not to mention destroying and burning savannah vegetation. The decline in livestock has also decreased the availability of local manure and therefore fertilizer, forcing farmers to rely more heavily on imported chemical fertilizers, the price of which has been escalating in recent years, together with the increase in gasoline prices. Finally, the chemical fertilizers available were said to be less effective for water retention than organic alternatives, so of declining utility as heat and water stress grew.

RESPONSES

Although heat is, indeed, rising and will continue to do so, the area is not condemned and could thrive. As mentioned earlier, the critical need is to prioritize local entrepreneurship, so that farmers can have better access to wider markets and higher prices for their goods. In reality, there has actually been only one tomato factory in the region, which apparently suffered from management problems. The skills required to oversee such operations are not yet present in the region, so people from outside have been brought in to run this type of industry. However, farmers were not guaranteed better prices, as the factory exercised a monopoly and would pay only low prices, despite being able to sell goods at much higher rates. Moreover, most farmers have no means to transport their goods to the factory. These problems could be solved by following the successful models of other communities which have already surmounted similar issues (Motiram and Vakulabharanam, 2007; Buse et al., 2008).

A range of other responses could

be taken to stem and reverse the steady erosion of rural livelihoods in Bolgatanga. Some promising programmes were ongoing in the promotion of Bolgatanga basket weaving to generate improved livelihood opportunities, especially during the relative downtime of the dry season. Bolgatanga baskets are a unique, indigenous handcraft woven by hand exclusively by women. The activity allows local women to earn respectable incomes, with immediate benefits for the promotion of maternal and child health for participating families. Handicraft activities, from basket weaving to leather goods and pottery, help to diversify the livelihoods and supplement subsistence farming, now increasingly at risk because of climate change.

Enabling the farmers to produce more crops during the dry season would also make a significant difference. There is enough rain over a year to ensure wider irrigation, but there were either not enough dams or reservoirs trapping the rain, or too many of these had silted up and become ineffective. Overhauling and building new dams is far beyond the means of local farmers and even the local government. International support can be extremely useful here—there are already some support programmes for dam rehabilitation, and these provide jobs during construction and beyond, representing a sustainable solution for the community. The same was true for less costly water wells, although it was not reported whether the pumping more water from the groundwater aquifer was sustainable or not. However, many did report that wells had dried up. Enlarging and linking an existing set of wilderness reserves already under conservation protection could help to strengthen biodiversity, with benefits for natural pest control, as well as water catchment. Local composting using on-site crop waste close to fields, and household food waste in vegetable gardens closer to houses, could help to offset the decrease in local fertilizer.

FLOODING AND THE BAGRÉ DAM

Evidence of excess rainfall is seen in the visible flood damage sustained to earthen buildings and is clearly documented with photographic evidence shown to the research team. One major issue is the release of water following heavy rains from the Bagré Dam in southern Burkina Faso; the area around the dam has experienced increasing rainfall in recent years (ICI, 2010). When the floodgates are opened, large areas of the plains in northern Ghana become inundated with water. The local community is defenceless as the water floods across the plains, unable to penetrate the densely packed, arid soil. Aside from damaging buildings, water that remains for several days destroys any crops that are submerged and increases the risk of malaria by greatly expanding the breeding ground for mosquitoes. Local experts suggested the problem could be addressed by building better drainage infrastructure, in combination with the construction or rehabilitation of feeder roads—small roads that are a sound investment under any circumstances (Stifel et al., 2012; Kingombe, 2011). Ensuring that waterways are not used for cropping, but for the planting of trees to reinforce embankments was another solution put forward. However, with declining fertility and scope for planting crops elsewhere, the fertile embankments with direct access to water are too attractive for farmers. Cooperation with Burkina Faso on infrastructure solutions that might help to release water gradually following heavy rains had apparently not been addressed.



EAST COAST: VOLTA DELTA

The east coast lies at the southeast extremity of Ghana, close to the border with Togo along the Gulf of Guinea. The researchers visited villages across the Greater Accra and Volta regions of Ghana, as well as Prampram, Ada Foah, and Keta. While the south of Ghana is less hot and more humid than the far north, the southeast coast itself has a dry climate within the coastal savannah zone of Ghana, which, according to EPA-Ghana, is due to “coastal alignment and upwelling of cold water” (EPA-Ghana, 2011). Not that it is cold here: truck drivers complained of more frequent tire and windshield explosions on the hottest days. Parents worried that teachers were becoming less effective in educating their children, as they struggled to work in the growing heat during school hours. The area is mainly a low-lying plain, interspersed with a number of lagoons and tributaries at the delta of the Volta River, which originates in Burkina Faso. It is predominantly a fishing and agrarian community, and the area visited is home to over half a million people (Ghana SS, 2010). The chief climate change concerns for the southeast coastal areas relate to coastal erosion/sea-level rise, fisheries, agriculture and health. Biodiversity, drought, energy for cooling and water are also concerns. As for much of the country, labour productivity and occupational heat stress are also important issues, and concerns over migration were additionally flagged by local experts, who emphasized a constant drain of men and families out of the area. Fisheries are in long-term decline in the area for a variety of reasons, including over-fishing, but research provides strong evidence for the negative impact on marine ecosystems of both rising sea temperatures and ocean acidity. The Gulf of Guinea is understood to be one of the zones worst hit by rising temperatures (Cheung et al., 2010). Coastal erosion in the area has a long history, with dramatic rates of degradation and residents asserting “several

kilometres” of land lost to the sea in certain places around the Volta Delta, where sea defences have not been put in place. The agricultural sector has been affected both by the heat and by salt intrusion and land erosion due to sea-level rise, although large areas of land are irrigated by the Volta River and are more resilient to the growing heat. In health terms, malaria was still a common health problem for residents of the area, and malnutrition was raised as a serious concern. Diarrheal diseases were apparently less prevalent than was the case for northern Ghana, since it was understood that plumbed/improved water sources and sanitation or latrines were more common in the coastal Volta area.

COASTAL EROSION AND SEA-LEVEL RISE

Analysis of Ghana’s coastline shows that over the last few decades the eastern coast has eroded at the fastest rate. Rates of annual erosion have been estimated in the range of 1-11 metres per year of land (Ly, 1980; Wiafe 2010; Appeaning Addo et al., 2011). Coastal erosion in the area has been noticeable for over a century, suggesting some degree of natural oscillations in delta growth and loss (Akyaempong, 2001; Oteng-Abbabio et al., 2011). In addition to claiming land and damaging coastal infrastructure, the erosion is also affecting water resources and soil quality from the penetration of salt from the sea as it seeps further inland. It has forced the relocation of residents who have abandoned their homes and properties along the coast and moved inland. Risks are particularly high during elevated seasonal tides or storm tides that can inundate tracts of land and severely damage infrastructure, livelihoods, and endanger lives. Sea-level rise due to climate change is a significant cause of concern in the coastal erosion of Ghana. However, research has highlighted several other important issues. These include the construction of the Volta/Akosombo

hydroelectric dam built in the 1960s, which withholds vital sediments that would otherwise be released into the delta from the Volta River; sediment to the littoral delta has been reduced by 10 times according to some estimates (Boateng, 2009). The erosion processes may have doubled since the building of the dam (Ly, 1980). Given that water flow is now controlled, the natural flooding patterns of the area have also changed and the flood plains now rely on irrigation and a reduced water supply (Corcoran et al., 2007). The hydro dam in itself is a positive response to the causes of climate change as a renewable energy generator, but it also presents a unique dilemma here because the dam exacerbates the consequences of climate change, in particular, sea-level rise erosion.

Other important concerns highlighted include the practice of sand mining and the construction of coastal infrastructure and sea-defences (Oteng-Abbabio et al., 2011; Appeaning Addo and Larbi, 2009). Sand removed from the shorefront obviously accelerates erosion, while the construction of coastal infrastructure affects sea-wave dynamics and concentrates energy on adjacent unprotected areas. Even if the entire Ghanaian coast were protected, Togo and Côte d’Ivoire on either side would be more exposed, since it is hard to imagine the possibility of protecting the entire Gulf of Guinea coastline. Residents and officials in Keta were insistent that the construction of the major seaport at nearby Tema during the early 1960s changed the velocity and energy pattern of the waves, further accelerating coastal erosion. A port further distant, on the border of Togo, was also a source of concern. Clearing and degradation of littoral mangrove forests has made matters even worse. Finally, the local practice of pumping out groundwater via “tube irrigation” was very common, even for fields close to the water’s edge. In other parts of the world, irrigation using ground-water has been shown

to accelerate land subsidence and perceived sea-level rise (Larson et al., 2001). Similar irrigation techniques were also common in the Mekong delta of Vietnam, also highly vulnerable to sea-level rise and studied in this report. In the context of all these varied and significant concerns, sea-level rise resulting from climate change is a very unwelcome new consideration for a community highly vulnerable and already having great difficulty coping with local coastal erosion. A series of large-scale coastal defences have already been built, and local experts have emphasized the sensible preference of “soft” approaches, such as re-vegetation of sand dunes or beach nourishment, over “hard” infrastructure coastal defence options (Oteng-Abbabio et al., 2011). Little information was obtainable about the feasibility of sediment pass-through retrofits to the Volta/Akosombo hydroelectric dam, although retrofitting options are available and would merit further investigation and investment given the scale of impact manifested (IPCC, 2012b). However, clearly the re-establishment of coastal mangrove forests and providing alternatives to ground-water pumping for irrigation would be less expensive than infrastructure-intensive solutions; for example, one single coastal defence construction near Keta cost 90 million US dollars (Armah, 2005). “Soft” approaches are also likely to cause less, if any, collateral damage. There appeared to be few mechanisms in place to compensate households that lost property and needed to relocate or who are subject to damage. If the sea level rises one or two metres during the 21st century—assuming that climate change is not sufficiently brought under control—the whole situation threatens to become quite dire (IPCC, 2007; RSNZ, 2010; Füssel in Edenhofer et al., 2012).

FISHERIES

Local observations of the rise in sea temperatures and some indications of decline in local marine life match global assessments (Wiafe et al., 2008). The

CLIMATE 	2010	2030
Contraction of biological zones (km ²) - yearly average	-3,000	-6,000
Additional land degraded due to climate change (km ²) - yearly average	750	1,500
Additional/reduced energy load due to climate change (GWh) - yearly average	350	900
Additional CO ₂ generated/reduced for heating and cooling due to climate change (kt CO ₂) - yearly average	60	150
Share of workforce particularly affected by climate change (%) - yearly average	55%	45%
Additional land lost due to climate change (km ²) - yearly average	15	35
Additional water losses/gains due to climate change (km ³) - yearly average	0.25	0.25

community was unanimous that there are simply fewer fish. This applies equally to inland and offshore fish stocks. As with sea-level rise, climate change driven sea temperatures and CO₂-related acidification of the oceans are not the only causal factors. As with many other social, economic, and environmental challenges, climate change is rarely, if ever, the only factor causing problems. Population growth increases the number of fishermen, resulting in damaging fish practices, such as the use of small gauge nets or even dynamite, and the practically uncontrolled intensification of large-scale commercial operations has not favoured sustainable management of fish stocks.

Two other climate change-related factors have also worsened the situation for fishermen. More volatile, unpredictable, and extreme weather is a serious safety hazard. Some fishermen cannot swim and the small fishing boats are often at serious risk on this high-energy coastline, especially in the case of fierce, unpredictable storms. Second, the retreat of the shore has pushed the blue-water shelf, where most fishing takes place, further away with each passing decade and add to labour, time, cost, and risks for fishermen in small craft.

Large and heavily equipped foreign fishing boats from China, Japan, and Korea ply the offshore waters of the region for fish that are explored from the port base in nearby Tema directly to Asia. In Keta, however, there is no fish processing industry, such as a freezing works, for packaging the catch of local fishermen. Locals rely only on "middle men" who truck the Keta catch back to Accra. Most of the fish leaving for Accra is sold smoked. Local fishermen stated that the smoking of fish used to be permitted by burning the less useful remains of the once bountiful catch. However, the falling fish harvest means that local trees and forests are instead used for fuel, and this has reportedly exacerbated local deforestation concerns. Moreover,

degradation of mangrove forests in the delta—with mangrove wood serving as firewood—damages marine and inland fishery biodiversity in an interlinked vicious cycle (Concoran et al., 2007). Responding to the full range of issues affecting the mainstay fisheries industry of the region is not a straightforward matter. Fishing is still a significant industry for the Ghanaian economy as a whole, and its rapid decline will clearly not add to the wealth and social cohesion of the nation. The only solution currently being explored seriously is the establishment of fish farms, for which a few select pilot projects were taking hold, to the great interest of the local industry. Regulation of foreign commercial fishing was dismissed as "unrealistic" under current circumstances, even if only to limit fish net gauge, so that the smallest fish would escape unharmed while promoting the continual replenishment of stocks. Once again, the preservation of the local mangrove forests represents an obvious positive response, with multiple benefits, even if steps towards implementation are unexplored and doubtful. Yet another avenue to be explored, which could lower the vulnerability of the community through expanded incomes is providing incentives and creating an enabling environment for local entrepreneurs to establish fish processing industries to generate value-added goods with broader market potential. Other options worthy of consideration are certified, sustainable fishing programmes and the establishment of marine reserves.

CARBON 	2010	2030
Volume of water to treat (millions m ³) - yearly average	250	350



CONCLUSION

The hallmarks of climate stress are clearly evident in the everyday life and the local environment of Ghana, whether in downtown Accra—recovering from unprecedented floods—or in coastal and northern savannah regions. More areas were not visited, but the National Workshop organized as a part of the research undertaken did highlight several other zones of the country facing still different and significant pressures characteristic of those areas, some of which are also documented in local research (Asante et al., 2010; EPA-Ghana, 2011; Tachie-Obeng et al., 2011). In every case, climate change stress met head-on with local issues not caused by climate change. In Accra, the floods were exacerbated by poor drainage and waste disposal methods. In the Volta delta, coastal infrastructure, unsound irrigation, and the upstream Volta hydro dam compounded one another in a context of growing climate-related sea-level rise. In the northern region of Ghana, local deforestation and savannah burning wove complex interrelationships with the extreme heat and water stress that was eroding the rural livelihoods in an area that in former times was the breadbasket for Ghana. With 50 additional days that could be considered "hot" in every current year, as compared with Ghana's climate in the 1960s, the heat has nevertheless only just begun to increase; a doubling, trebling, or more of the temperature increase is expected over the next 20–30 years, given the inertia of the global climate system (McSweeney et al., 2012; Hansen et al., 2005). Thus, future climate stresses are likely to be extreme and will continue to exploit the economic, social, and environmental weaknesses of Ghana, and retard economic growth and social and human development potential, especially among the poorest communities. However, steps taken by the government are heading in a promising direction, and the success and relative stability of Ghana compared with other countries in the region make it an interesting candidate for a more concerted effort. United with the international community, Ghana has the potential to show the way in tackling the local impacts of climate change as they are increasingly coming to the fore.